Stiles, Ch. Wardell -

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myself, and must have used them in a moment of mental aberration. I should have said that the bolometer had given us most of the reliable data concerning the absorption and transmission of radiant energy by the atmosphere, although at that time I fully believed, both from a general knowledge of Prof. Langley's work, and from conversations with him, that the atmosphere was a pretty good valve. Prof. Davis's references and a recent study of the published data show that the valve is leaky indeed. Still, if the atmosphere absorbs 50% of the Sun's radiations, and 50% of those from the earth, we have 25% of the Sun's radiations let in and not let out. If we take the figures which I believe Langley recommends, 70% for the solar, and 40% for the terrestrial radiations, we should have a catch of 40% of that originally arriving from the Sun.

Many unexplained points concerning this complex problem continually appear. What becomes of the 30–40% of the solar radiations and the 40% of terrestrial radiations absorbed by the atmosphere? It has but little mass and low specific heat, and yet it does not get hot, except in its lower layers. This source of energy it seems to me would be more than sufficient for all meteorological phenomena. Prof. Langley's data, voluminous and wonderful as they are, still appear incomplete in certain very important directions, leaving a very attractive field for investigation.

As to terminology, it seems to me very convenient to speak of 'heat rays' so long as we know exactly what we mean by the expression. We are all familiar with 'light rays,' and a 'heat ray' is the same thing, only, as Maxwell says, considered in its 'thermal aspect.' The term 'ray' is no doubt bad, but it is convenient and should be permissible with a tacit understanding that it is only a makeshift term. It would, of course, be better if we had some term to signify energy in its radiant form, as to direction of propagation, wave front, etc., but so long as we have not, and inasmuch as we all recognize its identity, why not use the old names and avoid multiplication of words. Even Prof. Langley's 'Luminous heat' ought to mislead no one; evidently he refers to the heat effects of that kind of radiant energy which is also capable of producing light effects; 'dark heat rays' are incapable of so doing. When Professor Langley speaks of the 'radically different character of the heat in two maxima' he refers, of course, to their different wave-lengths. A similar remark about a treble and bass note would not mislead any one into the idea that both were not sound. I fail to see what is wrong with the last quotation from my article, or exactly what is meant by the 'mis-recognition of the early part of this century.'

I sympathize most sincerely with Professor Davis in his demand for precise terminology, but we must not allow even this worthy desire to lead us into complexities of expression which may be even more fatal to perspicuity than old terms with modern significations.

W. HALLOCK.

COLUMBIA COLLEGE, October 11, 1895.

A REPLY.

EDITOR OF SCIENCE: If it be fair to presume, as does Dr. Emory McClintock on page 453–4 of SCIENCE, under a heading which I think should be 'Professor Halsted Corroborated,' that because neither in a private letter nor in print one specifies his many mistakes, therefore one did not disapprove both his 'half on Saccheri as well as the half on Gauss,' then I must beg of SCIENCE a line to say that among other mistakes in this letter of his, he is completely wrong in saying of me: "He found that the two words *diuturnum prœlium* were meant by Saccheri to indicate a mental attitude of constant war against the 'hypothesis' as heretical."

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS, October 7, 1895.

THE RUDOLF LEUCKART CELEBRATION.

SEVERAL months ago the following circular (Cf. SCIENCE, Vol. I., p. 187) was sent out from Leipzig,s igned by about a hundred and fifty scientists from various parts of the world:

"*Zur Feier des am 13 December, 1895, stattfindenden fünfzigjährigen Doctorjubiläums von Rudolf Leuckart*, dem Nestor unter den deutschen Zoologen, dessen Wirken weit über den Kreis seiner Specialwissenschaft hinausreicht, fordern die ergebenst Unterzeichneten zu Beiträgen auf. Im Herzen seiner zahlreichen

Verehrer steht es fest, dass der seltene Tag nicht vorbei gehen darf ohne ein dauerndes Zeichen der Erinnerung. Wir gedenken von einem hervorragenden Bildhauer 'Leuckart's Marmorbüste' herstellen zu lassen und sie zugleich mit einer künstlerisch ausgestatteten Adresse zu überreichen.

"Wir wenden uns an alle, welche in ihrem geistigen Entwickelungsgange sein Wirken und seinen Einfluss verspürt haben, dass sie zu einer würdigen Ehrung des Jubilars beisteuern.

"Da es unmöglich ist, die Adressen aller seiner Schüler, namentlich derer, die nicht Zoologen von Fach geblieben sind, zu erlangen, so bitten wir diejenigen Herren, welche der allgemeinen Anregungen, die sie aus Leuckart's Vorlesungen in ihren Beruf mit hinausgenommen haben, in Dankbarkeit gedenken, dass sie in ihren Kreisen durch Verbreitung dieses Aufrufs in unserem Sinne thätig sind.

"Beträge werden erbeten an Herrn Carl Graubner (C. F. Winter's Verlag, Leipzig, Johannesgasse 8), welcher das Amt des Schatzmeisters freundlichst übernommen hat."

Within a few weeks of the receipt of the circular by American zoölogists I received a number of inquiries from various sources asking for further information regarding the subject, but was unable to reply to these inquiries, as I had not learned the detailed plans of the Leipzig Committee. At present, however, I can furnish some of the desired information, and, as the time is very short, will utilize the columns of SCIENCE for this purpose.

It is the intention of the Leipzig Committee to have a life-size marble bust of the Geheimrath made and to present it to him on December 13th, and it is understood that the bust will eventually be deposited in the University at Leipzig or in the Leipzig Gallery. The statue will be made by one of the most prominent sculptors of Germany, who attended Leuckart's lectures this last semester, unbeknown to the lecturer, in order to study his expression. The estimated cost is 4,000 marks, of which about 1,000 marks had been subscribed before September 1st. Should more money be collected than is necessary it will probably be spent for photographs of the bust which will be sent to persons who have forwarded subscriptions.

The subscriptions thus far made vary from 10 to 200 marks, most of them being in sums of 20 to 50 marks.

It is not intended to confine the subscriptions to Leuckart's pupils, for a number of other persons have expressed their desire to contribute. The Leipzig Committee therefore extends a cordial invitation to all admirers of the Geheimrath to join in the celebration, and I would therefore urge all of Leuckart's pupils in this country to bring this circular to the attention of their scientific and medical friends.

Subscriptions can be sent to Carl Graubner, as announced in the original circular, or to me. At the request of Dr. Simroth, the moving spirit in the undertaking, I have agreed to receive American subscriptions and forward the same in one sum to Leipzig.

CH. WARDELL STILES.

U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

TO THOSE INTERESTED IN QUATERNIONS AND ALLIED SYSTEMS OF MATHEMATICS.

DEAR SIRS: The mathematical ideas associated with the direct treatment of vectors and vector functions are daily becoming more familiar to the scientific mind. Half a century ago the broad principles of vector theory were laid down in the Quaternions of Hamilton and the Ausdehnungslehre of Grassmann. In his second monumental work Hamilton developed a vector calculus of great power and flexibility, peculiarly appropriate to geometry and physics; while both systems, in their richness of transformations, generality of treatment, simplicity of expression and interpretation, surpass any other known forms of mathematics. Nevertheless, these systems have not received the attention that is surely their due, and remain still in a comparatively undeveloped state.

Meanwhile, in connection chiefly with the remarkable advance in electrical theory, the growing necessity for a vector calculus, or at least for a compact vector notation, has induced more recent investigators to invent new systems, which have very much in common with those already established by Hamilton and Grassmann.